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A Soil Study in Scott County, Kansas*

Paper 27 of the 1925 Meeting at Manhattan

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The geological formation of Scott county is Tertiary (1), (2), a period in which there occurred a heterogeneous deposit of sand, gravel, clay, and soil above the previous Cretaceous formation. The loose unconsolidated materials comprising the Terteriary formations are derived from Rocky Mountain wash.

The land under study covered four townships southwest of Scott City. In general it may be described as an area rather flat in topography with a gradual slope toward the east and having a soil that is quite uniform in texture and color. A dark brown silt loam with a porous silty clay loam sub-soil light grey or yellow in color is typical of the region. The soil lying west and south of the town of Shallow Water may probably be classified as belonging to the Colby Soil series and the soil north and west as containing areas

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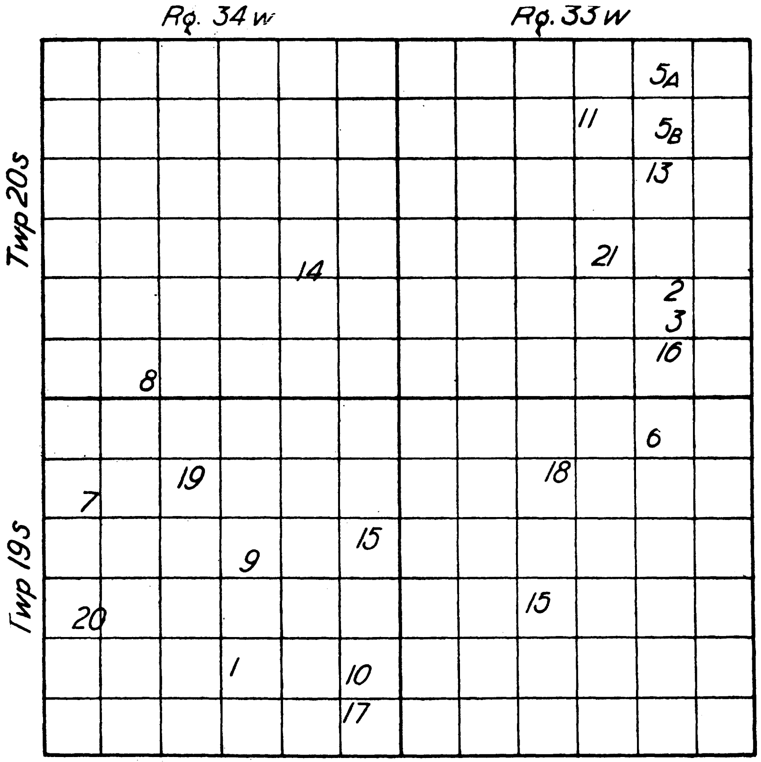

Fig. 1—Diagram showing location of soil samples

of Scott clay loam and Scott Silt loam series. Where gravel is in evidence in river channels it is composed of granite, syanite porphyry, andesite, rhyolite, basalt, and pure quartz.

Each soil sample taken for analysis represents a composite of about twelve seven inch borings, taken at the points indicated in figure 1. The subsoil samples were taken with a steel tube to a depth of six feet.

TABLE I. Average Soil Analyses of the Samples by Townships.

	No.	Nitrogen		Phosph.		Calcium		Inorgan. Carbon		Organ. Carbon		Total Carbon	
	Sam	sur.	sub.	sur.	sub.	sur.	sub.	sur.	sb.	sur.	sb.	sur.	sub
R 34W T 19S	2	.141		.059		.362		neg.		1.49		.149	
R 34W T 20S	8 - 1	.124	.032	.057	.056	.377	5.34	neg.	1.53	1.44	.36	.120	1.89
R 33W T 19S	4 - 3	.140	.051	.067	.061	.747	2.56	pos.	0.58	1.46	.51	.150	1.22
R 33W T 20S	3	.128		.058		.433		pos.		1.41			1.41

Table 1 presents the average soil analyses of the samples, by townships. Subsoil samples represent the sixth foot. The soils are low in percentage of nitrogen compared with the average amount of nitrogen in productive soils in humid regions, which is 0.20 percent for the surface seven inches. On the basis of 2,000,000 pounds as the acre weight of the surface seven inches of soil, this amounts to 4,000 pounds of nitrogen per acre.

The Scott County soils with 0.124 to 0.14 percent nitrogen would contain approximately 2,520 pounds of nitrogen per acre. According to Swanson (3), cultivated soils in eastern Kansas contain 3,7000 pounds of nitrogen per acre in Riley County; 2,960 pounds in Russell County; 2,800 pounds in Butler County; and 2,440 pounds in Allen county. Sod lands in these eastern counties contains over 4,000 pounds of nitrogen per acre. The amount of nitrogen present in the native sod lands of Scott County is no doubt sufficient for crops grown under conditions of limited rainfall. Whether the soils would respond to applications of nitrogen when under irrigation depends upon the question of fixation of free nitrogen by western soils.

Headden (4) found that Colorado soils showed an increase in nitrogen content where the soils were maintained in a moist condition by irrigation, this increase being due to nitrogen fixing organisms. Gainey (5) of the Kansas Agricultural Experiment Station has shown that Azotobacter are active in fixing nitrogen when the soils are neutral or slightly alkaline in reaction and are well supplied with organic matter. It is possible that western Kansas soils may contain more nitrogen through nitrogen fixing bacteria when irrigation brings about optimum moisture conditions.

Buffalo grass does not afford much herbage to be returned to the soil and thus develop an accumulation of organic matter. Soils with this character of native vegetation are necessarily low in organic matter.

Organic matter is considered to be composed of 50 percent carbon. The Scott County soils contain 1.49 to 1.41 percent organic carbon. With 1.49 percent, the soils would contain 59,600 pounds of organic matter per acre; with 1.41 percent 56,400 pounds per acre. Native buffalo sod in Russell county in the west central zone of the state was reported by Swanson (3) to contain 98,400 pounds of organic matter per acre; and native pasture in Butler County in the eastern zone, 106,400 pounds. However, in Reno County, native pasture contains but 74,800 pounds of organic matter. When compared with these more eastern counties, the Scott County soils are low in organic matter.

Regarding the water relations of soils, their absorption and retentive capacities for water are greatly augmented by organic matter in its various states of decomposition. A system of irrigation in this western region should include the incorporation of organic matter in the soil. This practice would not only improve the moisture conditions of the soil, but would maintain a soil structure that would safeguard any tendency toward blowing; furthermore, additions of organic matter would supply carbohydrate material needed to furnish energy for nitrogen fixing organisms.

The soils under study are remarkably high in phosphorus. The amount of phosphorus in the average productive soil has been estimated as 0.04 percent. These soils contain approximately 0.06 percent in the surface soil and the same amount in the subsoil down to the depth sampled which was six feet.

There is an abundant supply of calcium particularly in the subsoil. The surface soils are either neutral or alkaline in reaction.

No determinations were made of the amount of potassium because earlier analyses of soils in Finney County, adjoining, had shown an abundant supply of potassium. Similar supplies of potassium had also been found in other western counties.

The soils were tested for alkali salts and were found negative except for two sixth foot samples which gave indication of a tract of sulphates.

Water samples were taken from four domestic wells which varied in depth from 27 to 46 feet. One of the wells located near the town of Shallow Water contained 1100 parts per million of soluble salts. This well was 27 feet in depth. The amount of salts in the other three wells sampled were negligible. The water analyses are given in Table II.

TABLE II. WATER SAMPLES

1.	337 P. P. M.	Total solids
2.	197 P. P. M.	Total solids
3.	1119 P. P. M.	Total solids
	774 P. P. M.	Sodium sulphate
	345 P. P. M.	Calcium carbonate
	30 P. P. M.	Calcium sulphate
	Practically no chlorides	
4.	226 P. P. M.	Total solids

The well containing 1100 parts per million of total solids in the water was across the road from an irrigation well. The salts in solution were 744 parts per million sodium sulphate. This is a considerable amount of sodium sulphate for water that is used for either domestic or irrigation purposes.

In consideration of the question of the use of this water for irrigation purposes, references may be made to the analyses of some characterstic alkaline river waters in Kansas and Colorado. The Cache la Poudre, two miles above Greeley, Colorado, contains 1571 parts per million total solids, 60 percent being sulphates. The Platte River below Cache la Poudre, Colorado, contains 1,011 parts per million total solids, of which 55 percent are sulphates. The Arkansas at Rocky Ford, Colorado, contains 2,134 parts per million total parts of which 60.7 percent are sulphates. These streams are the source of irrigation water for districts noted for their productive agriculture. The well water in question contains 1,100 parts per million total solids of which 744 parts per million are sulphates. From the available experiments reviewed by Harris

Hilgard (7) states that although 685 parts per million of the common alkali salts should be the limit under most conditions, the nature of the salts modify the limits considerably. Where salts are of the sodium sulphate type, Forbes (8) states that with good drainage 1,000 parts per million of salts in irrigation is an objectionable but permissible degree of salinity for Arizona.

Salt grass is the native sod near the domestic well, the water of which has been discussed. Although salt grass (Distichlis spicata) occurs on soils containing from 30,000 to 50,000 part per million of salts, yet it does well in soils containing practically no salt. It does not show preference for the type of alkali nor for the concentration.

"Buffalo wallows" characterize the region in which the soil samples were taken and the native vegetation is buffalo grass. These wallows or sinks may vary in diameter from severel feet to about three hundred feet. Samples were taken to a depth of seven inches on about 25 sink areas and composited for chemical analyses. These soils contained sodium sulphate which probably accounts for their deflocculated physical condition. The surface is low in nitrogen, otherwise its analysis is similar to the other soils. These sink areas have a normal porous subsoil beneath the surface ten inches of slick gumbo soil.

(6) the toxic limits of sodium sulphate in soils lie between 2,500 and 5,000 parts per million.

The buffalo wallows or sink areas have been originally natural depressions caused by unequal settling of the surface mantle. Buffalos probably did wallow in the soft, moist soil of these depressions and carried away much soil as mud, plastered to their backs. When the soil was dry these areas probably furnished a place for the herds to bunch and throw dust in fighting insects.

TABLE III. SOIL ANALYSES. SCOTT COUNTY. (Elements expressed in percentages.)

	Nitrogen		Phosphorus		Calcium		Inorganic Carbon		Organic Carbon		Total Carbon	
	Surf.	Subs.	Surf.	Subs.	Surf.	Subs.	Surf.	Subs.	Surf.	Subs.	Surf.	Subs.
Range 33W. Twp. 19 S.												
Samples 13	0.150		.071		1.590		.33		1.48		1.81	
Sod 5A—3rd ft.		0.043		.054		2.520		.61		.39		1.00
Sod 5B—6th ft.		0.065		.070		2.18		.48		.75		1.23
11	0.145		.072		.400		Neg.		1.59		1.59	
21	0.138		.061		.384		Neg.		1.51		1.51	
Sink area 2—18"—7'		0.035		.060		4.26		1.11		.33		1.44
3	0.126		.063		.615		.04		1.08		1.12	
Normal 16—18"—7'		0.046		.063		2.980		.65		.40		1.05
Twp. 20 S.—6 part sod	0.133		.062		.384		Neg.		1.53		1.53	
Sandy soil—18	0.111		.054		.460		Pos.		1.20		1.20	
Sod—15	0.139		.060		.456		Pos.		1.50		1.50	
Range 34 W. Twp. 19 S												
Samples 14 sod	0.138		.061		.36		Neg.		1.52		1.52	
Sod 8	.144		.057		.344		Neg.		1.47		1.47	
Range 34 W Twp 20 S. 12	.124		.060		.36		Neg.		1.29		1.29	
Sod 10—6th ft.		.032		.56		5.34		1.53		.36		1.89
Sod 1	.132		.052		364		Pos.		1.22		1.22	
Sod 4	.130		.058		.348		Neg.		1.42		1.42	
9	.131		.056		.405		Neg.		1.24		1.24	
19 sandy soil	.115		.055		.392		Pos.		1.23		1.23	
7 sod	.106		.056		.296		Neg.		1.22		1.22	
20 sod	.130		.059		.344		Neg.		1.51		1.51	
17 sod	.124		.063		.512		Pos.		1.33		1.33	
Scomposite of Sink areas	.089		.071		.663		.04		.96		1.00	

The depressions naturally formed and deepened by buffaloes in the above manner allowed the accumulation of salts as water collected from surface drainage evaporated. Sodium sulphate as one of the accumulated salts increased the puddled condition of the soil by its deflocculating action.

The puddled condition of the buffalo wallows can probably be remedied by the use of lime and the incorporation of organic matter. By changing the soil structure the puddled condition well be corrected and natural sub-drainage restored.

Table III presents the complete data of the soil analyses and permits a study of the unifomrity of the soil within the area of the four townships.

Except for the samples from the sandy loam soils, the variation in nitrogen is from 0.126 to 0.15 percent. Phosphorus varies from 0.057 to 0.07 percent.

The few samples taken from ridges that were composed of a sandy rather than of a silt loam contained less nitrogen and phosphorus than the silt loam which is the dominant soil class.

The chemical analyses of the soil and water, together with observation during a period of several years lead to the conclusion that the soils of this region are very productive; the moisture is the limiting factor in crop production; and that the feasibility of pumping water from wells for irrigation is only a question of pumping costs compared with the value of the crops grown.

Literature Cited

1. Haworth, Erasmus, 1897. Physical Properties of the Tertiary. Uni. Geol. Surv. Kan., 2:247-284.
2. -------------------- 1913. Special Report on Well Waters. Uni. Geol. Surv. Kan. Bul. 1, 1-110.
3. Swanson, C. O., 1915. The loss of nitrogen and Organic Matter in cultivated Kansas Soils and the Effect of this Loss on the Crop Producing Power of the Soil. Jour. Ind. and Eng. Chem. 7; 529-532.
4. Headden, W. P., 1922. Fixation of Nitrogen in Colorado Soils. Colo. Agr. Exp. Sta. Bul. 277, 48 pp.
5. Gainey, P. L., 1923. A Study of the Effect of Changing the Absolute Reaction of Soils upon their Azotobacter Content. Reaction of Soils upon their Azotobacter Content. Jour. Agr. Res. 24, 289-296.
6. Harris, F. S., 1920. Soil Alkali. 258 p. John Wiley & Sons, N. Y.
7. Hilgard, E. W., 1906. Soils. 593 p. The MacMillan Co., N. Y.
8. Forbes, R. H., 1902. The River Irrigating Waters of Arizona. Their Character and Effects. Ariz. Agr. Exp. Sta. Bul. 44, pp. 145-214.